National Aeronautics and Space Administration

Major NASA Development Programs
Program Cost Estimates

This special section of the FY 2002 budget justifications provides information about major NASA programs that are either in the design and development phase or have not completed their initial operational phase. In several instances, information about programs that are not "major" but are of special interest has been included. The budgetary estimates are expressed in millions of dollars of *budget authority*. * Estimates of the FY 2000 and prior fiscal year budget authority are the "actual" amounts. The FY 2001 amounts are consistent with the latest FY 2001 operating plan. The amounts for FY 2002 and future fiscal years are expressed in "real year" economics, that is, they include an adjusting factor for the future inflation expected to be experienced. If the term "constant dollars" is used in the budget justifications, that phraseology indicates that the numbers do not include inflationary adjustments beyond the fiscal year referenced (e.g., "constant FY 1996 dollars").

The estimates provided below are intended to be comprehensive, including all related mission-unique costs, but there are limitations. The direct and indirect costs incurred by foreign governments or other federal agencies in support of these missions have not been included. The estimates of civil service costs have been included, but these estimates should be considered preliminary, and they will continue to be refined as the agency moves toward full cost accounting over the next several years.

* *Budget authority* is a term used to represent the amounts appropriated by the Congress in a given fiscal year; *budget authority* provides government agencies with the authority to obligate funds. The ensuing obligations, cost incurrence, and expenditures (outlays) can differ in timing from the fiscal year in which Congress provides the *budget authority* in an appropriations act.

Alternate Turbopump Development

Funding to begin development of an alternate design for the two turbopumps driving the Space Shuttle's Main Engine was initiated in FY 1987. The development of a new high-pressure oxygen turbopump and hydrogen fuel turbopump was undertaken to improve the safety, reliability, producibility, and maintainability of the current turbopumps. After an initial period of design and development, problems experienced in early development testing and accompanying increased costs resulted in suspension of the fuel turbopump's development, while development activities concentrated on the oxygen turbopump. Although further development problems were encountered with the oxygen turbopump, their successful resolution led to Congress agreeing in Spring 1994 to resumption of the fuel turbopump's development. The first flight of the oxygen turbopump occurred in 1995, and the initial flight of the fuel pump is currently planned for 2001, rescheduled from late 1997 due to development problems. The budgetary estimate of $980.9 million includes not only the funding required for the design, development, and extensive testing of these two types of turbopumps, but also the funding needed to produce the flight turbopumps for installation into the main engines for the four-orbiter fleet.

The budgetary estimates provided below are the amounts included in the Human Space Flight appropriation for this program. They do not include the amounts for the use of government facilities and general and administrative support used to carry out the development. A more detailed exposition of the program goals, objectives and activities is provided in the specific budget justification narrative for the Space Shuttle program.

(Budget Authority in Millions of Dollars)

	PRIOR	2000	2001	2002	2003	2004	2005	2006	BTC	TOTAL
DEVELOPMENT	729.6	21.5	6.2	6.3						763.6
PRODUCTION	157.4	16.5	22.1	21.3						217.3
TOTAL EXCLUDING CIVIL SERVICE COSTS ($M)	887.0	38.0	28.3	27.6						980.9
(ESTIMATED CIVIL SERVICE FTEs)	(561)	(23)	(19)	(11)						
CIVIL SERVICE COMPENSATION ESTIMATE ($M)	31.9	2.1	1.9	1.1						

Checkout and Launch Control System (CLCS)

A new Checkout and Launch Control System (CLCS) was approved for development at KSC in FY 1997. The CLCS will upgrade the Shuttle launch control room systems with state-of-the-art commercial equipment and software in a phased manner to allow the existing flight schedule to be maintained. The CLCS will reduce operations and maintenance costs associated with the launch control room by as much as 50%, and will provide the building blocks to support future vehicle control system requirements. The Juno and Redstone phases were delivered in FY 1997. In these phases, the initial integration platform was defined, the engineering platform installed and the interface with the math models was established. The Thor delivery was completed in FY 1998. During this phase, initial ground databus interfaces were established and the system software was ported to the production platforms. The Atlas delivery in FY 1999 provided support for the Orbiter Processing Facility were developed, the final applications for the Hypergolic Maintenance Facility, the math model validation, an interface to the Shuttle Avionics Integration Lab (SAIL), and hardware testing for SAIL. The Titan delivery will provide support for completion of development and the start of validation testing for application software used for Shuttle Orbiter power-up testing. The Scout phase of CLCS is planned to support operational use in the Orbiter Processing Facility and development of Pad and launch-related application software. The Delta and Saturn phases include completion of all launch application development, completion of software certification and validation, and a complete integrated flow demonstration. Since the FY 1999 Budget, software independent validation and verification (IV&V) performed by Ames Research Center was also added to this project. By the end of FY 2004, Operations Control Room-1 will be fully operational, followed by certification. The first Shuttle launch using the CLCS is scheduled for FY 2005 with full implementation to be completed one year later**.**

The budgetary estimates provided below are the amounts included in the Human Space Flight appropriation for this program. This represents an increase of $165.2M over the FY 2001 Budget to Congress estimate of $233.3M. The new launch capable date is 3rd quarter FY 2005 a delta of 37 months. They do not include the amounts for the use of government facilities and general and administrative support used to carry out the development activities. A more detailed exposition of the program goals, objectives and activities is provided in the specific budget justification narrative for the Space Shuttle program.

(Budget Authority in Millions of Dollars)

	PRIOR	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**BTC**	**TOTAL**
DEVELOPMENT COSTS	114.8	42.2	55.8	61.0	52.1	37.5	26.6	8.5		398.5
TOTAL EXCLUDING CIVIL SERVICE COSTS ($M)	114.8	42.2	55.8	61.0	52.1	37.5	26.6	8.5		398.5
(ESTIMATED CIVIL SERVICE FTEs)	(267)	(125)	(118)	(121)	(110)	(78)	(39)	(7)		
CIVIL SERVICE COMPENSATION ESTIMATE ($M)	21.8	10.5	10.6	11.3	10.8	8.1	4.2	0.8		

TDRS Replenishment Spacecraft Program

The Tracking and Data Relay Satellite (TDRS) Replenishment Spacecraft program ensures sufficient spacecraft will be available to continue Space Network operations into the next century. The program provides three additional TDRS satellites and ground terminal modifications through a fixed price, commercial practices contract with Boeing (previously Hughes Space and Communications Company) company. This innovative approach has deleted or greatly reduced Government specifications and documentation requirements, allowing the contractor to pursue commercial practices; this has resulted in efficiencies in both cost and development lead time.

These satellites will incorporate Ka-band frequencies, where space research has a primary allocation, into the high data rate services provided via the high gain, single access antennas. The single access services at S-band and Ku-band will be retained, remaining backward compatible with the existing, first generation TDRS satellites. These satellites will also provide an enhanced multiple access service with data rates up to three megabits per second. The first spacecraft (TDRS-H) was launched in June 2000. The second spacecraft (TDRS-I) is scheduled for launch in November 2002.

The estimates do not include costs for use of government facilities and general and administrative support used to carry out the program. A more detailed exposition of the program goals, objectives and activities is provided in the specific budget justification for the program within the Space Operations section. Projected runout cost estimate has been reduced by $4.1M from last year's estimate due to reduced acquisition costs for the expendable launch vehicle.

(Budget Authority in Millions of Dollars)

	PRIOR	2000	2001	2002	2003	2004	2005	2006	BTC	TOTAL
SPACECRAFT DEVELOPMENT AND GROUND TERMINAL MODIFICATIONS	479.6	17.7	14.4	57.7	6.5					575.9
LAUNCH SERVICES	106.9	14.0	36.5	67.8	37.0					262.2
TOTAL EXCLUDING CIVIL SERVICE COSTS ($M)	586.5	31.7	50.9	125.5	43.5					838.1
(ESTIMATED CIVIL SERVICE FTEs)	(215)	(32)	(30)	(29)	(29)					
CIVIL SERVICE COMPENSATION ESTIMATE ($M)	15.1	3.3	3.2	3.2	3.3					

Earth Observing System

Before the Earth Observing System (EOS) was authorized in November 1990 in the FY 1991 budget as a new start, EOS planning had been in progress for over eight years. The EOS is key to achieving the objectives set forth in the Earth science program plan and the overall goal and scientific objectives of the interagency U.S. Global Change Research Program. EOS is an international science program, drawing upon the contributions of Europe (ESA), Canada, and Japan both in terms of spacecraft and instruments. This extraordinary collaboration is essential to reach the objective of providing comprehensive measurements of the nature of global climate change.

At its outset, the EOS program was based on the flights of two series of large platforms, in addition to platforms from Japan and ESA and instruments carried on Space Station Freedom. The initial estimates provided to Congress focused on the period through fiscal year 2000. The initial estimate of $18-21 billion included development, mission operations, data analysis, launch services, communications, construction of facilities and the amounts carried in the Space Station program for the polar platform's development. In the FY 1992 appropriations process, Congress directed NASA to modify the scope and cost of the program. The cost through FY 2000 was to be reduced by $5 billion, the FY 1993 funding level had to be reduced, and NASA was to examine the feasibility of using smaller platforms. In 1991, the program was restructured to employ five smaller flight series. In 1992, in response to the constrained budget environment, NASA further rescoped the program by implementing a common spacecraft approach for all flights after the first morning (TERRA) spacecraft, increasing reliance on the cooperative efforts of international and other government agencies, and adopting a build-to-cost approach for the first unit of a multiple instrument build. The estimated NASA funding through FY 2000 was further reduced to $8.0 billion in this effort.

In the FY 1995 budget process, the program cost estimate was further adjusted downward by approximately $0.9 billion, of which $0.3 billion reflected an accounting transfer for small business innovative research out of individual programs into a common NASA account, and $0.1 billion reflected the change to lower-cost launch vehicles. The further reductions in program funding were addressed in 1994 through a program rebaselining activity. A number of small spacecraft were introduced into the program flight plans. In addition, alterations were made in flight phasing and accommodations were provided for a follow-on instrument to the enhanced thematic mapper being flown in 1999 on Landsat-7. Funding for the science investigations and data analysis was separated from the algorithms being developed to convert the instrument data into information. This change recognized the close relationship to similar science investigations and data analysis funded in the Earth Science research and analysis account. (The amounts budgeted for EOS science are shown in the table below.) In addition, it was decided to incorporate the development funding for the Landsat-7 into the EOS program in light of the integral ties between the two activities.

In the FY 1996 budget process, the amounts reflected the related program costs for Landsat-7 activities previously funded by the Department of Defense.

The 1997 Biennial Review completed the shift in planning for future missions that began in the 1995 “reshaping” exercise. Emerging science questions drive measurement requirements, which drive technology investments in advance of instrument selection and mission design. Mission design includes such options as purchase of science data from commercial systems and partnerships with other Federal agencies and international agencies. The result is a more flexible and less expensive, approach to acquiring Earth science data.

The ESE recognizes that the pathways of global change research lead from specialized studies of fundamental processes to the integration of individual findings into interactive models of the global Earth system, which can eventually deliver reliable predictions of natural or human-induced environmental phenomena. Long, consistent time-series of global environmental measurements are needed to document changes in forcing parameters and corresponding variations in the state of the Earth system, as required to explore the range of natural variability and test mathematical models of the phenomena. While diagnostic studies based upon long time series of global measurements can reveal the nature of the underlying mechanisms, focused process studies are indispensable to identify and model the basic physical, chemical and biological processes involved. Understanding these component processes is crucial in order to achieve the goal of constructing reliable predictive models of the Earth system. For this reason, the ESE aims to achieve a proper balance between long-term systematic measurements of key forcing or response parameters, and specialized process research. As it deploys EOS, ESE is also planning for the future. The ESE has developed a science research plan, which will drive the selection of the EOS follow-on missions. For example, a Landsat Data Continuity Mission is being formulated in partnership with USGS, and will be implemented as a commercial data purchase if possible. ESE is also planning for the transition of several of its key research observations to the Nation’s weather satellite system. The DoD, NOAA and NASA have established an Integrated Program Office (IPO) to create a converged civilian and military weather satellite system called the National Polar-orbiting Operational Environmental Satellite System (NPOESS) to replace the present generation of separate systems. NASA and the IPO are jointly funding the NPOESS Preparatory Project that will simultaneously continue key measurements begun by EOS and demonstrate instruments for NPOESS. The NPOESS Preparatory Project will save money for both organizations by combining essential atmospheric and Earth surface observations on a single platform, and by seeking to meet both climate science and operational weather requirements with the same advanced instruments.

The budgetary estimates below represent funding included in the Science, Aeronautics and Technology appropriation except for the amount for the Space Station platform. The amounts below reflect the effects of the rescoping of the EOS program, the impacts of the ZBR, and the inclusion of the estimate for FY 2006. They do not include the costs of the non-program-unique government facilities and general and administrative support used to carry out the research and development activities. A more detailed description of the program goals, objectives and activities is provided in the specific budget justification narrative for the program within the Earth Science section.

(Budget Authority in Millions of Dollars)

Earth Observing System	Prior	2000	2001	Subtotal Through FY 2000	2002	2003	2004	2005	2006	Total Through FY 2006
MORNING (Terra)	1,212.6	12.4	3.3	1,228.3	2.4					1,230.7
AFTERNOON (Aqua)	743.4	85.9	53.5	882.8	14.5	2.0	2.0	1.9		903.2
AURA	338.9	112.8	99.5	551.2	80.6	71.7	0.1			703.6
SPECIAL SPACECRAFT	488.3	121.1	111.2	720.6	56.4	21.1	15.9	15.0	14.3	843.3
ICESAT	87.3	52.3	53.3	192.9	12.7					205.6
SEAWINDS	127.6	6.8	5.8	140.2	3.0	1.7	0.5	0.4	0.2	146.0
JASON	50.6	13.1	3.8	67.5						67.5
SORCE		30.2	24.5	54.7	16.7	4.0	2.0	2.0	2.0	81.4
ACRIM	26.0	3.0	1.6	30.6	1.5	1.5	1.3	0.5		35.4
SAGE	64.0	3.0	0.5	67.5	0.1	0.1	0.1	0.1	0.1	68.0
Scisat ELV		3.4	9.6	13.0	9.1					22.1
Other prior (e.g.TRMM CERES/LIS, Solstice, TSIM, SIMBIOS, lightening mapper)	56.2			56.2						56.2
Program support	76.6	9.3	12.1	98.0	13.3	13.8	12.0	12.0	12.0	161.1
QUIKSCAT	84.3	1.1	1.1	86.5	3.3					89.8
LANDSAT 7	439.3	9.8	1.4	450.5	1.7	1.7	1.9			455.8
EOS FOLLOW-ON	8.4	15.0	55.0	78.4	129.6	286.1	322.3	306.6	252.6	1,375.6
ALGORITHM DEVELOPMENT	553.0	121.7	89.3	764.0	83.4	59.8	55.6	52.4	49.0	1,064.2
TECHNOLOGY INFUSION *	234.0	72.6	93.2	399.8	74.2	53.4	65.4	67.8	98.2	758.8
EOSDIS	1,606.8	278.9	281.4	2,167.1	252.7	252.9	282.9	270.9	268.2	3,494.7
SUBTOTAL	5,709.0	831.3	788.9	7,329.2	698.8	748.7	746.1	714.6	682.3	10,919.7
PHASE B	41.0			41.0						41.0
SPACE STATION PLATFORM	104.0			104.0						104.0
EOS SCIENCE	46.4	55.0	48.4	149.8	54.3	53.7	55.7	58.2	60.3	432.0
LAUNCH SERVICES	282.2			282.2						282.2
CONSTRUCTION OF FACILITIES	96.7			96.7						96.7
($M)	6,279.3	886.3	837.3	8,002.9	753.1	802.4	801.8	772.8	742.6	11,875.6
(ESTIMATED CIVIL SERVICE FTEs)	(4,226)	(545)	(478)		(455)	(427)	(410)	(407)	(404)	
CIVIL SERVICE COMPENSATION ESTIMATE ($I	302.7	47.3	43.2		43.5	40.9	39.2	39.0	38.7	

* In FY 01 Submit, Technology Infusion moved to R&T.

EOS New Millennium Program and Technology Infusion

The New Millennium Program (NMP) and Technology Infusion budget reflects a commitment to develop new technology to meet the scientific needs of the next few decades and to reduce future EOS costs. The program objectives are to spawn "leap ahead" technology by applying the best capabilities available from several sources within the government, private industries and universities. The first mission EO-1, has been selected to demonstrate innovative technology to produce Landsat data. The Space-Readiness Coherent Lidar Experiment (SPARCLE) was the second EO mission. The project was terminated due to cost growth. However, the progress in the lidar technology development is still useful for future remote systems. A Geostationary Imaging Fourier Transform Spectrometer was selected as the EO-3 mission. The concept will test advanced technologies such as large area focal-plane array, new data readout and signal processing electronics, and passive thermal switching, which will be used for measuring temperature, water vapor, wind and chemical composition with high resolution in space and time. The EO-3 project is currently in formulation, moving toward a Preliminary Design Review in March 2001.

(Budget Authority in Millions of Dollars)

	PRIOR	2000	2001	2002	2003	2004	2005	2006	TOTAL
EO-1 (INCLUDES LAUNCH SERVICES)	156.6	23.7	10.3						190.6
EO-2 SPARCLE (STS ATTACHED PAYLOAD)	11.4								11.4
EO-3		7.8	34.0	30.0	7.3	13.4	6.6	4.0	103.1
NMP TECHNOLOGY & FUTURE FLIGHTS (INCLUDES LAUNCH SERVICES)	4.7	3.7	5.7	5.8	5.8	11.7	20.9	53.9	112.2
ADV. INFORMATION SYSTEMS TECH.	6.5	12.6	15.4	9.5	9.8	9.8	9.8	9.8	83.2
ADVANCED TECH INITIATIVES	22.0	9.8	12.8	8.9	8.5	8.5	8.5	8.5	87.5
INSTRUMENT INCUBATOR	32.8	15.0	15.0	20.0	22.0	22.0	22.0	22.0	170.8
TOTAL EXCLUDING CIVIL SERVICE COSTS	234.0	72.6	93.2	74.2	53.4	65.4	67.8	98.2	758.8
(ESTIMATED CIVIL SERVICE FTEs)	(224)	(68)	(39)	(30)	(29)	(32)	(30)	(30)	
CIVIL SERVICE COMPENSATION ESTIMATE ($M	17.9	5.9	3.5	2.9	2.8	3.1	2.9	2.9	

Earth Explorers

The Earth Explorer program is the component of Earth Science that addresses unique, specific, highly focused mission requirements in Earth science research. The program is designed to have the flexibility to take advantage of unique opportunities presented by international cooperative efforts, small satellites and advanced technical innovation. Earth Explorers complement the Earth Observing System by enabling investigations needing special orbits or other unique requirements. The missions are developed using short cycles of 1-3 years. The currently approved Earth Explorers are the Total Ozone Mapping Spectrometer (TOMS), Triana, and Earth System Science Pathfinders (ESSP) missions.

The Experiments of Opportunity funding will accommodate opportunities to provide flight instruments and technologies on non-Earth science missions, foreign or domestic, or on airborne experiments. The Lewis and Clark missions were transferred from the Office of Space Access and Technology when that office was dissolved. The LightSAR was cancelled in FY 1999; however, SAR studies will continue under the Technology Infusion Program. The SRTM is a reimbursable mission with the National Imaging and Mapping Agency (NIMA). The UnESS program was cancelled in 2001.

The budgetary estimates below represent funding included in the Science, Aeronautics and Technology appropriation. The program is designed as an ongoing program. The budget estimates immediately below do not include the estimated costs incurred by the international collaborators, mission operations, science costs, related funding included in the Earth Observing System program, use of government facilities and general and administrative support used to carry out the research and development activities. A more detailed description of the program goals, objectives and activities is provided in the specific budget justification narrative for the program within the Earth Science section.

(Budget Authority in Millions of Dollars)

	PRIOR	2000	2001	2002	2003	2004	2005	2006	TOTAL
TOTAL OZONE MAPPING SPECTROMETER (TOMS)	127.3	24.5	0.1						151.9
NASA SCATTEROMETER (NSCAT)	210.0								210.0
TROPICAL RAINFALL MEASURING MISSION (TRMM)	246.0								246.0
TRIANA	35.9	35.1	24.9						95.9
LEWIS & CLARK	130.4								130.4
UNIVERSITY CLASS EARTH SYSTEM SCIENCE (UNESS)		2.3	0.5						2.8
EARTH SYSTEM SCIENCE PATHFINDERS	100.1	90.0	111.5	84.0	121.0	115.7	147.2	167.4	Continues
VCL	42.3	19.0	13.7						75.0
GRACE	45.4	24.6	16.1	6.5	1.6	1.6	0.8	0.2	96.8
PICASSO	5.0	24.8	26.4	29.1	15.8	2.5	2.1		105.7
CLOUDSAT	2.0	19.1	47.6	37.7	18.1	3.1	1.6		129.2
Future Missions/Prog support	5.4	2.5	7.7	10.7	85.5	108.5	142.7	167.2	Continues
LIGHTSAR/SAR DEVELOPMENT	12.0								12.0
EXPERIMENTS OF OPPORTUNITY	5.0	1.0	0.5	0.5	0.4	0.5	0.5	0.5	Continues
SRTM		10.2	3.7						13.9
TOTAL EXCLUDING CIVIL SERVICE COSTS ($M)	866.7	163.1	141.2	84.5	121.4	116.2	147.7	167.9	
(ESTIMATED CIVIL SERVICE FTEs)	(1015)	(152)	(99)	(76)	(86)	(102)	(121)	(120)	
CIVIL SERVICE COMPENSATION ESTIMATE ($M)	70.9	13.2	8.9	7.3	8.2	9.8	11.6		

Total Ozone Mapping Spectrometer

The TOMS Earth Probes project is a follow-on to the Total Ozone Mapping Spectrometer (TOMS) instrument flown with such great success on the Nimbus-7 spacecraft in 1978. A TOMS instrument was also flown on the Russian METEOR spacecraft in 1991. The TOMS program consists of a set of instruments (flight models 3, 4, 5) and one small spacecraft. Flight model 3 was launched on the TOMS Earth probe spacecraft on July 2, 1996. Flight model 4 was launched on the Japanese ADEOS spacecraft on August 17, 1996. The ADEOS-I spacecraft failed on June 30, 1997. Flight model 5 has been completed, and was scheduled to fly as a cooperative mission with Russia in late 2000. However, Russia has indicated that it cannot meet that launch date. Presently, the Agency has completed its re-planning and will fly FM-5, as QuikToms, on a U.S. vehicle and spacecraft in June 2001.

(Budget Authority in Millions of Dollars)

	PRIOR	2000	2001	2002	2003	2004	2005	2006	TOTAL
DEVELOPMENT	127.3	24.5	0.1						151.9
MISSION OPERATIONS	2.7	3.2	6.9	6.5	2.7				22.0
SCIENCE TEAMS	0.9	1.0	1.0	1.0	0.9	1.0	1.0	1.0	7.8
SELV	16.7								16.7
TOTAL EXCLUDING CIVIL SERVICE COSTS ($M)	147.6	28.7	8.0	7.5	3.6	1.0	1.0	1.0	198.4
(ESTIMATED CIVIL SERVICE FTEs)	(159)	(19)	(7)	(6)	(6)	(5)	(5)	(5)	
CIVIL SERVICE COMPENSATION ESTIMATE ($M)	10.9	1.6	0.6	0.6	0.6	0.5	0.5	0.5	

Tropical Rainfall Measuring Mission

The Tropical Rainfall Measuring Mission (TRMM) was launched aboard the Japanese H-II vehicle November 27, 1997. The TRMM development began in FY 1992, after a four-year period of concept studies and preliminary mission definition. The TRMM objective is to obtain a minimum of three years of climatologically significant observations of tropical rainfall. TRMM data will be useful to understand the ocean-atmosphere coupling, especially in the development of El Niño events, which form in the tropics but whose effects are felt globally. The observatory spacecraft was built in-house at the Goddard Space Flight Center. The Japanese built a critical instrument, the Precipitation Radar. Two other instruments are being developed with TRMM program funding, the Visible and Infrared Scanner and TRMM Microwave Imager. In 1992, two EOS-funded instruments were added to the payload, the Clouds and Earth's Radiant Energy System (CERES) and the Lightning Imaging Sensor (LIS). The budget estimates provided below include the costs of accommodating these two instruments on the TRMM observatory. The EOS Data and Information System will have a specific capability for disseminating TRMM data.

(Budget Authority in Millions of Dollars)

	PRIOR	2000	2001	2002	2003	2004	2005	2006	TOTAL
DEVELOPMENT	246.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	246.0
EOS-FUNDED INSTRUMENTS/SCIENCE/DIS	[71.6]								[71.6]
MISSION OPERATIONS	10.9	11.1	14.7	15.6	17.3	8.5	0.0	0.0	78.1
SCIENCE TEAMS	14.3	11.3	16.3	15.7	6.1	0.0	0.0	0.0	63.7
RESEARCH & ANALYSIS-FUNDED SCIENCE	35.4								35.4
TOTAL EXCLUDING CIVIL SERVICE COSTS ($M)	306.6	22.4	31.0	31.3	23.4	8.5	0.0	0.0	423.2
(ESTIMATED CIVIL SERVICE FTEs)	(728)	(21)	(20)	(20)	(6)	(4)	(5)	(5)	
CIVIL SERVICE COMPENSATION ESTIMATE ($M)	50.2	1.8	1.8	1.9	0.6	0.4	0.6	0.6	

Space Infrared Telescope Facility (SIRTF)

The purpose of the Space Infrared Telescope Facility (SIRTF) mission is to explore the nature of the cosmos through the unique windows available in the infrared portion of the electromagnetic spectrum. SIRTF is the fourth of NASA's Great Observatories, which include the Hubble Space Telescope, the Compton Gamma Ray Observatory, and the Advanced X-Ray Astrophysics Facility. The funding plan provided below reflects a dramatic restructuring of the SIRTF design concept carried for many years. Rather than simply "descoping" the "Great Observatory" concept to fit within a $400 million (FY94 $) cost ceiling (through the end of development) imposed by NASA, scientists and engineers have instead redesigned SIRTF from the bottom-up. The goal was to substantially reduce costs associated with every element of SIRTF -- the telescope, instruments, spacecraft, ground system, mission operations, and project management. The Jet Propulsion Laboratory (JPL) was assigned responsibility for managing the SIRTF project. SIRTF is planned for launch on a Delta launch vehicle in July 2002.

The budgetary estimates below are the amounts included in the Science, Aeronautics and Technology appropriation for this program. They do not include the amounts for the definition phase studies carried out prior to FY 96. A more detailed exposition of the program goals, objectives and activities is provided in the specific budget justification narrative for the program within the Space Science section.

(Budget Authority in Millions of Dollars)

	PRIOR	2000	2001	2002	2003	2004	2005	2006	BTC	TOTAL
ATD	79.9									79.9
DEVELOPMENT	189.9	123.4	118.3	105.9						537.5
MISSION OPS					7.0	7.3	6.3	5.3	14.1	40.0
DATA ANALYSIS					61.8	61.2	65.1	64.7	214.8	467.6
TRACKING & DATA SUPPORT					tbd	tbd	tbd	tbd	tbd	tbd
TOTAL EXCLUDING CIVIL SERVICE COSTS ($M)		123.4	118.3	105.9	68.8	68.5	71.4	70.0	228.9	1125.0
(ESTIMATED CIVIL SERVICE FTEs)	(103)	(25)	(13)	(5)						
CIVIL SERVICE COMPENSATION ESTIMATE ($	3.4	2.3	1.3	0.8						

The Explorer Program

The Explorer program consists of small to mid-sized spacecraft conducting investigations in all space physics and astrophysics disciplines. The program provides for frequent, relatively low-cost missions to be undertaken as funding availability permits within an essentially level overall funding profile for the program. The funding profile provided below covers the design and development phase, launch services, mission-unique tracking and data acquisition support, mission operations and data analysis. It does not include costs for the use of government facilities and general and administrative support required to implement the program. A more detailed exposition of the program goals, objectives and activities is provided in the specific budget justification narrative for the program within the Space Science section.

(Budget Authority in Millions of Dollars)

	PRIOR	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**BTC**	**TOTAL**
*Explorers launched before FY 2000 (MO&DA)	226.7	32.7	30.7	26.2	9.5	9.1	6.6	7.4	Continuing	
*Imager for Magnetospause-to-Aurora Global Exploration	129.6	11.2	7.1	7.1	2.5	1.0				158.5
*Microwave Anisotropy Probe	87.9	28.0	22.9	3.7	2.6	0.7				145.8
*Swift Gamma-Ray Burst Explorer		22.2	49.1	47.4	35.2	4.1	3.9	2.8		164.7
*Full-sky Astrometric Mapping Explorer		5.2	20.0	61.7	39.2	32.4	3.7	3.5		165.7
*Small Explorers (HESSI, GALEX, TWINS)	79.7	49.0	41.3	16.7	10.6	6.6	4.4	3.5		204.1
*HETE-II	20.3	5.6	1.5	1.0						28.4
*STEDI (SNOE, TERRIERS, CATSAT, CHIPS & IMEX)	50.0	3.4	11.1	6.2	1.5					38.6
*Planning & Future Developments		3.4	5.7	31.3	121.4	191.5	283.0	316.6	Continuing	
TOTAL EXCLUDING CIVIL SERVICE COSTS ($M)		160.7	189.3	201.3	222.5	245.4	301.6	333.8		
(ESTIMATED CIVIL SERVICE FTEs)		(203)	(210)	(214)	(172)	(152)	(118)	(118)	Continuing	
CIVIL SERVICE COMPENSATION ESTIMATE ($M)		16.5	16.4	17.1	15.0	14.0	12.0	12.4	Continuing	

*Tracking estimate is not included

Imager for Magnetopause-to-Aurora Global Exploration

Development on the Imager for Magnetopause-to-Aurora Global Exploration (IMAGE) began in FY 1997. The IMAGE mission is using three-dimensional imaging techniques to study the global response of the Earth's magnetosphere to variations in the solar wind, the stream of electrified particles flowing out from the Sun. The magnetosphere is the region surrounding the Earth controlled by its magnetic field and containing the Van Allen radiation belts and other energetic charged particles. Southwest Research Institute developed the IMAGE mission, which launched successfully in March 2000 aboard a Delta-7326 (Med-Lite Class ELV).

(Budget Authority in Millions of Dollars)

	PRIOR	2000	2001	2002	2003	2004	2005	2006	BTC	TOTAL
DEVELOPMENT	84.5	4.7								89.2
LAUNCH SUPPORT	45.1	1.7								46.8
MISSION OPERATIONS		0.4	0.4	0.1						0.9
DATA ANALYSIS		4.4	6.7	7.0	2.5	1.0				21.6
TOTAL	129.6	11.2	7.1	7.1	2.5	1.0				158.5

Microwave Anisotropy Probe

Development on the Microwave Anisotropy Probe (MAP) began in FY 1997. The MAP mission will undertake a detailed investigation of the cosmic microwave background to help understand the large-scale structure of the universe, in which galaxies and clusters of galaxies create enormous walls and voids in the cosmos. GSFC is developing the MAP instruments in cooperation with Princeton University. MAP will launch in summer 2001 aboard a Delta-7326 (Med-Lite Class ELV).

(Budget Authority in Millions of Dollars)

	PRIOR	2000	2001	2002	2003	2004	2005	2006	BTC	TOTAL
DEVELOPMENT	59.2	13.3	12.1							84.6
LAUNCH SUPPORT	28.7	14.7	6.4							49.8
MISSION OPERATIONS			1.5	2.1	1.5					5.1
DATA ANALYSIS			2.9	1.6	1.1	0.7				6.3
TOTAL	87.9	28.0	22.9	3.7	2.6	0.7				145.8

Swift Gamma-Ray Burst Explorer

Swift is a three-telescope space observatory for studying the position, brightness, and physical properties of gamma ray bursts. Although gamma ray bursts are the largest known explosions in the Universe, outshining the rest of the Universe when they explode unpredictably in distant galaxies, their underlying nature and cause remain mysteries. Swift was selected in October 1999 as a MIDEX mission, and is planned for launch in September 2003.

(Budget Authority in Millions of Dollars)

	PRIOR	2000	2001	2002	2003	2004	2005	2006	BTC	TOTAL
DEVELOPMENT		22.2	33.5	30.5	16.2					102.4
LAUNCH SUPPORT			15.6	16.9	17.5					50.0
MISSION OPERATIONS						2.6	1.9	2.0		6.5
DATA ANALYSIS					1.5	1.5	2.0	0.8		5.8
TOTAL		22.2	49.1	47.4	35.2	4.1	3.9	2.8		164.7

Full-Sky Astrometric Mapping Explorer (FAME)

FAME is a space telescope designed to obtain highly precise position and brightness measurements of 40 million stars. This rich database will enable numerous science investigations, including accurately determining the distance to all of the stars on this side of the Milky Way galaxy, detecting large planets and planetary systems around stars within 1,000 light years of the Sun, and measuring the amount of dark matter in the galaxy from its influence on stellar motion. FAME was selected in October 1999 as a MIDEX mission, and is planned for launch in October 2004.

(Budget Authority in Millions of Dollars)

	PRIOR	2000	2001	2002	2003	2004	2005	2006	BTC	TOTAL
DEVELOPMENT		5.2	20.0	46.1	20.3	11.2				102.8
LAUNCH SUPPORT				15.6	18.9	19.2				53.7
MISSION OPERATIONS						1.2	1.1	1.2		3.5
DATA ANALYSIS						0.8	2.6	2.3		5.7
TOTAL		5.2	20.0	61.7	39.2	32.4	3.7	3.5		165.7
		48.8	37.0	8.4	2.8	1.4	0.8			

Mars Exploration Program

The newly reformulated Mars Exploration Program is pursuing four major goals and objectives: (1) to determine if life ever arose on Mars, and if it still exists today; (2) to characterize Mars's ancient and present climate and climate processes; (3) to determine the geological processes affecting the Martian interior, crust, and surface; (4) to prepare for human exploration of Mars, primarily through environmental characterization.

The newly restructured Mars Exploration Program (MEP) will deliver a continuously refined view of Mars with the excitement of discovery at every step. The MEP strategy will respond to new science investigations that will emerge as discoveries are made. The strategy is linked to our exploration experience here on Earth, including experience in deep sea exploration and petroleum deposit searches, and uses Mars as a natural laboratory for understanding life and climate on Earth-like planets other than our own.

The basic scientific approach to achieving these goals is one of "Seek, In-Situ, and Sample". In the initial phases – and relying heavily on orbital instruments – the MEP will survey Mars to identify scientifically interesting areas in global context. Following this phase, more detailed measurements will be made by long-lived assets on the surface, allowing in-situ laboratory analyses to refine the interpretations developed during the previous orbital reconnaissance phase and confirm from the ground the observations made in orbit. Finally, samples of scientifically significant components of the Martian atmosphere, surface, and subsurface will be returned to Earth for definitive analytical investigation in ways that are not possible to be performed on the surface of Mars.

The funding profile provided below covers the design and development phase, launch services, mission-unique tracking and data acquisition support, mission operations and data analysis. It does not include all costs for the use of government facilities and general and administrative support required to implement the program. A more detailed exposition of the program goals, objectives and activities is provided in the specific budget justification narrative for the program within the Space Science section.

(Budget Authority in Millions of Dollars)

	PRIOR	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**BTC**	**TOTAL**
MARS GLOBAL SURVEYOR (MGS)	220.5	18.8	17.5	10.2						267.0
1998 MARS ORBITER/LANDER	290.0	6.0								296.0
2001 MARS ODYSSEY	285.9	109.2	47.1	23.1	20.0	20.0	10.6			515.9
2003 MARS EXPLORATION ROVERS (MER)		18.9	302.0	207.0	118.5	48.6	4.7			699.7
FUTURE MISSIONS		121.1	100.5	234.3	364.7	504.9	676.5	565.0	Cont.	
TOTAL EXCLUDING CIVIL SERVICE COSTS ($M)		274.0	467.1	474.6	503.2	573.5	691.8	565.0	Cont.	
(ESTIMATED CIVIL SERVICE FTEs)		(64)	(89)	(97)	(98)	(75)	(75)	(65)	Cont.	
CIVIL SERVICE COMPENSATION ESTIMATE ($M)		5.7	7.1	7.7	8.0	6.6	7.0	6.2	Cont.	

Mars Global Surveyor (MGS)

Mars Global Surveyor (MGS), the first of the MEP missions, is an orbiter that carries a science payload comprised of 5 of the original 8 spare Mars Observer instruments aboard a small, industry-developed spacecraft. MGS was launched successfully in November 1996 aboard a Delta II launch vehicle and has been producing highly valuable science output since it arrived at Mars in September 1997. MGS completed its primary mission on January 31, 2001, and moved immediately into an extended mission phase. In the extended phase MGS will study the most interesting locations on the planet in detail and observe variability on the Martian surface. MGS will also study potential landing sights for the Mars 2003 rovers.

(Budget Authority in Millions of Dollars)

	PRIOR	2000	2001	2002	2003	2004	2005	2006	BTC	TOTAL
DEVELOPMENT	130.7									130.7
LAUNCH SUPPORT	52.6									52.6
MISSION OPERATIONS	23.9	12.8	9.1	4.3						50.1
DATA ANALYSIS	13.3	6.0	8.4	5.9						33.6
TOTAL	220.5	18.8	17.5	10.2						267.0

1998 Mars Orbiter/Lander

The ‘98 Mars Orbiter and Lander consisted of the Mars Climate Orbiter (MCO) and the Mars Polar Lander (MPL). MCO was intended to study the planet's weather for one Martian year, acquiring data to help scientists better understand the Martian climate. The MPL was to focus primarily on Mars' climate and water. The MPL mission would search for near-surface ice and possible surface records of cyclic climate change, and characterize physical processes key to the seasonal cycles of water, carbon dioxide and dust on Mars. MCO launched in December 1998 and MPL launched in January 1999; however, both missions failed upon arrival at Mars.

(Budget Authority in Millions of Dollars)

	PRIOR	2000	2001	2002	2003	2004	2005	2006	BTC	TOTAL
DEVELOPMENT	189.7									189.7
LAUNCH SUPPORT	90.7									90.7
MISSION OPERATIONS	9.4	5.6								15.0
DATA ANALYSIS										
TRACKING & DATA SUPPORT	0.2	0.4								0.6
TOTAL	290.0	6.0								296.0

2001 Mars Odyssey

The Mars 2001 Odyssey science objective is to determine the elemental and mineral composition of the surface, learn about the landforms, and measure the potential radiation hazards for future human exploration. The 2001 Mars Odyssey Orbiter is scheduled for launch in April 2001, will arrive at Mars in October 2001, and will begin the mapping orbit 45 to 90 days after orbit capture.

(Budget Authority in Millions of Dollars)

	PRIOR	2000	2001	2002	2003	2004	2005	2006	BTC	TOTAL
DEVELOPMENT	244.2	89.5	32.4							366.1
LAUNCH SUPPORT	41.7	19.7	5.9							67.3
MISSION OPERATIONS			5.8	14.1	10.4	10.1	3.8			44.2
DATA ANALYSIS			3.0	9.0	9.6	9.9	6.8			38.3
TRACKING & DATA SUPPORT			TBD	TBD	TBD	TBD				
TOTAL	285.9	109.2	47.1	23.1	20.0	20.0	10.6			515.9

2003 Mars Exploration Rovers (MER)

In 2003, two powerful new Mars rovers will be on their way to the red planet. With far greater mobility than the 1997 Mars Pathfinder rover, these robotic explorers will be able to trek up to 100 meters (about 110 yards) across the surface each Martian day. Each rover will carry a sophisticated set of instruments that will allow it to search for evidence of liquid water that may have been present in the planet's past. The rovers will be identical to each other, but will land at different regions of Mars. The rovers will be launched separately in May and June of 2003, and will arrive at Mars in October of 2004.

(Budget Authority in Millions of Dollars)

	PRIOR	2000	2001	2002	2003	2004	2005	2006	BTC	TOTAL
DEVELOPMENT		18.9	270.6	169.5	74.1					533.1
LAUNCH SUPPORT	[23.0]	[4.6]	31.4	37.5	32.2					101.1
MISSION OPERATIONS					3.6	27.3	4.7			35.6
DATA ANALYSIS					8.6	21.3				29.9
TRACKING & DATA SUPPORT					TBD	TBD	TBD			
TOTAL		18.9	302.0	207.0	118.5	48.6	4.7			699.7

Future Mars Exploration

Future Mars Exploration funds NASA missions, NASA participation in international cooperative missions to Mars and infrastructure supporting Mars missions, including: 2003 Mars Express (instruments for an ESA mission); 2005 Mars Reconnaissance Orbiter (MRO); 2007 Smart Lander; International Mars missions after 2003 (Telecom mission with ASI, netlander and Orbiter with CNES); U.S. competitively selected Mars missions; the first U.S. Mars Sample Return (MSR) Lander in 2011; Mars technologies; and construction of the Deep-Space-Network (DSN) 34M Beam Wave Guidance (BWG) Antenna to support the additional communications requirements of the new Mars program.

(Budget Authority in Millions of Dollars)

	PRIOR	2000	2001	2002	2003	2004	2005	2006	BTC	TOTAL
DEVELOPMENT + LAUNCH SUPPORT		120.7	87.3	223.9	353.6	489.7	658.7	522.1	cont.	
MISSION OPERATIONS		0.4	5.1	3.3	3.6	4.5	6.5	21.9	cont.	
DATA ANALYSIS			8.1	7.1	7.5	10.7	11.3	21.0	cont.	
TRACKING & DATA SUPPORT							TBD	TBD		
TOTAL		121.1	100.5	234.3	364.7	504.9	676.5	565.0		

Discovery Missions

The Discovery program provides frequent access to space for small planetary missions that will perform high-quality scientific investigations. The program responds to the need for low-cost planetary missions with short development schedules. Emphasis is placed on increased management of the missions by principal investigators. Missions are selected through open, peer-reviewed competitions, to ensure science community involvement while enhancing the U.S. return on its investment. The Discovery program also aids in the national goal to transfer technology to the private sector. The cost of building, launching, and operating a Discovery mission must not exceed $300 million in FY 01 dollars and the mission must launch within three years from start of development. Four Discovery missions have been launched: NEAR in February 1996, Mars Pathfinder in December 1996, Lunar Prospector in January 1998, and Stardust in February 1999. In addition, there are two Discovery missions currently in development (Genesis, launching in Summer 2001, and CONTOUR in July 2002), an instrument in development (ASPERA-3, which is to fly on the European Space Agency's Mars Express spacecraft in 2003), and two missions in formulation (MESSENGER, launching in March 2004, and Deep Impact launching in January 2004).

The budgetary estimates provided below are the amounts included in the specific budget justification for this program within the Space Science section in the Science, Aeronautics and Technology appropriation. Under the specific mission descriptions below, all direct program cost elements are included: the development of the spacecraft and experiments, mission operations, launch services and unique tracking and data acquisition services. The data below does not include costs for the use of government facilities and general and administrative support required to implement the program. A more detailed description of the program goals, objectives and activities is provided in the specific budget justification narrative for the program.

(Budget Authority in Millions of Dollars)

	PRIOR	2000	2001	2002	2003	2004	2005	2006	BTC	TOTAL
LUNAR PROSPECTOR	63.9	1.4								65.3
NEAR	202.2	13.2	10.0	1.5	3.0	3.0	1.5			234.4
STARDUST	170.7	4.3	4.6	4.3	5.6	6.8	5.6	6.6		208.5
GENESIS	127.3	62.3	32.3	6.9	7.4	2.8	2.1	1.5	0.3	242.9
CONTOUR	9.2	52.2	53.9	26.5	3.9	3.5	1.8	3.4		154.4
DEEP IMPACT	1.5	22.7	72.7	84.2	55.6	21.0	9.6	2.1		269.4
MESSENGER	1.7	9.6	52.0	97.4	64.7	35.2	7.0	6.9	51.7	326.2
FUTURE MISSIONS		3.5	8.9	9.0	99.2	202.3	266.1	273.1	Continuing	
TOTAL EXCLUDING CIVIL SERVICE COSTS ($M)		169.2	234.3	229.8	239.4	274.6	293.7	293.6		
(ESTIMATED CIVIL SERVICE FTEs)		(21)	(18)	(22)	(28)	(53)	(77)	(75)		
CIVIL SERVICE COMPENSATION ESTIMATE ($M)		2.1	1.4	1.9	2.7	5.3	8.0	8.2		

Near-Earth Asteroid Rendezvous (NEAR)

The NEAR Shoemaker mission was approved as a new start in FY 1994 as one of the initial Discovery Program missions. The NEAR mission was conducted as an in-house effort at the Applied Physics Laboratory, with many subcontracted subsystems. The NEAR spacecraft was designed to conduct a comprehensive study of the near-Earth asteroid 433 Eros, including its physical and geological properties and its chemical and mineralogical composition. The NEAR spacecraft was launched February 17,1996 on a Delta II launch vehicle. The original opportunity to rendezvous with the asteroid in January 1999 was lost when the spacecraft failed to fire its main engine properly. However, a subsequent firing was successful, and NEAR succeeded in its rendezvous with Eros in February 2000, NEAR performed flawlessly for a year before landing on the asteroid in February 2001. While the spacecraft is no longer operational, a competitive Data Analysis program is planned for the next several years.

(Budget Authority in Millions of Dollars)

	PRIOR	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**BTC**	**TOTAL**
DEVELOPMENT	124.9									124.9
LAUNCH SUPPORT	43.5									43.5
MISSION OPERATIONS	19.3	6.6	5.0							30.9
DATA ANALYSIS	14.0	6.4	4.8	1.5	3.0	3.0	1.5			34.2
TRACKING & DATA SUPPORT	0.5	0.2	0.2							0.9
TOTAL	202.2	13.2	10.0	1.5	3.0	3.0	1.5			234.4

Stardust

The Stardust mission was selected as the fourth Discovery mission in November 1995, with mission management from the Jet Propulsion Laboratory. The mission is designed to gather samples of dust from the comet Wild-2 and return the samples to Earth for detailed analysis. The mission will also gather and return samples of interstellar dust that the spacecraft encounters during its trip through the Solar System to fly by the comet. Stardust is using a new material called aerogel to capture the dust samples. In addition to the aerogel collectors, the spacecraft carries three additional scientific instruments. An optical camera will return images of the comet; the Cometary and Interstellar Dust Analyzer (CIDA) was provided by Germany to perform basic compositional analysis of the samples while in flight; and a dust flux monitor is used to sense particle impacts on the spacecraft. Stardust was launched on a Med-Lite expendable launch vehicle in February 1999 and has been performing well, with return of the samples to Earth expected in January 2006.

(Budget Authority in Millions of Dollars)

	PRIOR	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**BTC**	**TOTAL**
PHASE A/B	9.6									9.6
DEVELOPMENT	116.8									116.8
LAUNCH SUPPORT	40.8									40.8
MISSION OPERATIONS	1.0	1.0	3.8	3.6	4.7	5.2	4.6	5.7		29.6
DATA ANALYSIS	2.5	3.3	0.8	0.7	0.9	1.6	1.0	0.9		11.7
TOTAL	170.7	4.3	4.6	4.3	5.6	6.8	5.6	6.6		208.5

Genesis

In October 1997 NASA selected Genesis as the fifth Discovery mission. The Genesis mission is designed to collect samples of the charged particles in the solar wind and return them to Earth laboratories for detailed analysis. It is led by Dr. Donald Burnett from the California Institute of Technology, Pasadena, CA; JPL will provide the payload and project management, while the spacecraft will be provided by Lockheed Martin Astronautics of Denver, CO. Now planned for launch in Summer 2001, it will return the samples of isotopes of oxygen, nitrogen, the noble gases, and other elements to an airborne capture in the Utah desert. Such data are crucial for improving theories about the origin of the Sun and the planets, which formed from the same primordial dust cloud.

(Budget Authority in Millions of Dollars)

	PRIOR	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**BTC**	**TOTAL**
PHASE A/B	11.4									11.4
DEVELOPMENT	115.9	62.3	25.5							203.7
MISSION OPS			3.4	4.0	4.5					11.9
DATA ANALYSIS			2.9	2.4	2.4	2.8	2.1	1.5	0.3	14.4
TRACKING & DATA SUPPORT			0.5	0.5	0.5					1.5
TOTAL	127.3	62.3	32.3	6.9	7.4	2.8	2.1	1.5	0.3	242.9

Comet Nucleus Tour (CONTOUR)

In October 1997 NASA selected CONTOUR as the sixth Discovery mission. CONTOUR's goals are to dramatically improve our knowledge of key characteristics of comet nuclei and to assess their diversity. The spacecraft will leave Earth orbit, but stay relatively near Earth while intercepting at least two comets. CONTOUR builds on the exploratory results from the Halley flybys, and will extend the applicability of data obtained by NASA's Stardust and ESA's Rosetta missions to broaden our understanding of comets. The Principal Investigator is J. Veverka of Cornell University; the spacecraft and project management will be provided by the Johns Hopkins University Applied Physics Laboratory of Laurel, MD. Launch is expected in July 2002.

(Budget Authority in Millions of Dollars)

	PRIOR	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**BTC**	**TOTAL**
PHASE A/B	9.2	0.1								9.3
DEVELOPMENT		52.1	53.9	26.5						132.5
MISSION OPS					2.4	1.9	0.4	1.6		6.3
DATA ANALYSIS					1.5	1.6	1.4	1.8		6.3
TRACKING & DATA SUPPORT					TBD	TBD	TBD	TBD		TBD
TOTAL	9.2	52.2	53.9	26.5	3.9	3.5	1.8	3.4		154.4

Deep Impact

In July 1999 NASA selected Deep Impact as the seventh Discovery mission. It is designed to fire a mssive copper projectile into the comet P/Tempel 1, excavating a large crater more than 65 feet (20 meters) deep, in order to expose the comet’s pristine interior ice and rock. This will enable the flyby spacecraft to perform the first-ever study of unaltered cometary material. Deep Impact is led by Dr. Michael A'Hearn of the University of Maryland, College Park, the spacecraft will be provided by Ball Aerospace, and project management will be provided by the Jet Propulsion Laboratory. Launch is expected in January 2004.

(Budget Authority in Millions of Dollars)

	PRIOR	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**BTC**	**TOTAL**
PHASE A/B	1.5	22.7	15.5							39.7
DEVELOPMENT			57.2	84.2	55.6	15.0				212.0
MISSION OPS						4.6	6.9	0.7		12.2
DATA ANALYSIS						1.4	2.7	1.4		5.5
TRACKING & DATA SUPPORT						TBD	TBD	TBD		TBD
TOTAL	1.5	22.7	72.7	84.2	55.6	21.0	9.6	2.1		269.4

Mercury Surface, Space Environment, Geochemistry and Ranging (MESSENGER)

In July 1999 NASA selected MESSENGER as the eighth Discovery mission. The mission will send an orbiter spacecraft carrying seven instruments to globally image and study the closest planet to the Sun, in order to better understand the forces that have shaped the planet, as well as to better understand the evolution of terrestrial (rocky) planets generally. MESSENGER is led by Dr. Sean Solomon of the Carnegie Institution, Washington, D.C. The spacecraft and project management will be provided by the Johns Hopkins University Applied Physics Laboratory. Launch is expected in March 2004.

(Budget Authority in Millions of Dollars)

	PRIOR	2000	2001	2002	2003	2004	2005	2006	BTC	TOTAL
PHASE A/B	1.7	9.6	20.3							31.6
DEVELOPMENT			31.7	97.4	64.7	31.0				224.8
MISSION OPS						2.9	4.2	4.2	23.5	34.8
DATA ANALYSIS						1.3	2.8	2.7	28.2	35.0
TRACKING & DATA SUPPORT						TBD	TBD	TBD	TBD	TBD
TOTAL	1.7	9.6	52.0	97.4	64.7	35.2	7.0	6.9	51.7	326.2

Thermosphere, Ionosphere, Mesosphere Energetics and Dynamics (TIMED)

The TIMED mission is the first science mission in the Solar Terrestrial Probes (STP) Program, and is part of NASA's initiative aimed at providing cost-efficient scientific investigation and more frequent access to space for Sun-Earth Connections missions. TIMED was developed for NASA by the Johns Hopkins University Applied Physics Laboratory (APL). The Aerospace Corporation, the University of Michigan, NASA's Langley Research Center with the Utah State University's Space Dynamics Laboratory, and the National Center for Atmospheric Research provided instruments for the TIMED mission.

TIMED was planned to be ready for launch in May 2000 aboard a Delta II launch vehicle co-manifested with JASON, an Earth Science mission. However, due to Jason's inability to meet the launch date, the TIMED spacecraft is now scheduled for a summer 2001 launch. TIMED began its 36-month C/D development period in April 1997. The budgetary estimates below are the amounts included in the Science, Aeronautics and Technology appropriation for this program. They do not include the amounts for the definition phase studies carried out from April 1996 to April 1997.

(Budget Authority in Millions of Dollars)

	PRIOR	2000	2001	2002	2003	2004	2005	2006	BTC	TOTAL
DEVELOPMENT	123.4	21.4	13.3							158.1
MISSION OPERATIONS				2.0	0.8					2.8
DATA ANALYSIS		0.5	1.0	8.4	8.1	8.1	2.7	2.5		31.3
LAUNCH SUPPORT	24.6	6.1								30.7
TOTAL EXCLUDING CIVIL SERVICE COSTS ($I	148.0	28.0	14.3	10.4	8.9	8.1	2.7	2.5		222.9
(ESTIMATED CIVIL SERVICE FTEs)		25.0	2.0	3.0	3.0	3.0	3.0	3.0		
CIVIL SERVICE COMPENSATION ESTIMATE ($M)		2.2	0.4	0.2	0.2	0.2	0.2	0.2		

Stratospheric Observatory for Infrared Astronomy

The initial development funding for the Stratospheric Observatory for Infrared Astronomy (SOFIA) was requested in the FY 1996 budget. This new airborne observatory will provide a significant increase in scientific capabilities over the Kuiper Airborne Observatory, which was retired in October, 1995. The SOFIA will be accommodated in a Boeing 747 and will feature a 2.5-meter infrared telescope to be provided by the German Space Agency (DLR). SOFIA will conduct scientific investigations at infrared and submillimeter wavelengths.

The budget estimates provided below are the amounts included in the Science, Aeronautics and Technology appropriation for this program. They do not include the costs of preliminary design studies carried out in previous years, the amounts being contributed by the international participants, or costs for the use of government facilities and general and administrative support used to carry out the research and development activities. A more detailed exposition of the program goals, objectives and activities is provided in the specific budget justification narrative for the Space Science section.

(Budget Authority in Millions of Dollars)

	PRIOR	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**BTC**	**TOTAL**
DEVELOPMENT	148.3	42.0	38.9	37.0	42.9					309.1
MISSION OPERATIONS						40.4	42.7	42.8	CONT.	CONT.
TOTAL EXCLUDING CIVIL SERVICE COSTS	148.3	42.0	38.9	37.0	42.9	40.4	42.7	42.8		
(ESTIMATED CIVIL SERVICE FTEs)		73.0	65.0	42.0	23.0	23.0	23.0	23.0		
CIVIL SERVICE COMPENSATION ESTIMATE ($M)		7.0	6.4	4.5	2.5	2.6	2.8	3.0		

Deep Space 1

Deep Space 1 was selected in FY 1996 as the first New Millennium Program mission. DS 1 launched in October, 1998 on a Med-Lite-class Delta launch vehicle. All technologies completed their validation by the end of FY 1999 and included solar electric propulsion, an advanced solar array, autonomous primary navigation, and a miniature imaging camera spectrometer. The DS 1 mission has been extended to utilize its new technologies in a comet flyby. The supplemental technology development line below contains funding for crosscutting technology development efforts previously managed by the Office of Space Access and Technology.

(Budget Authority in Millions of Dollars)

	PRIOR	2000	2001	2002	2003	2004	2005	2006	BTC	TOTAL
DEVELOPMENT	99.3									99.3
SUPPLEMENTAL TECH DEV (included in Dev	[14.9]									[14.9]
MISSION OPERATIONS	8.1	3.0	2.1	0.3						13.5
DATA ANALYSIS	1.5	1.9	3.2	0.3						6.9
LAUNCH SUPPORT	45.4									45.4
TRACKING & DATA SUPPORT	0.3									0.3
TOTAL		4.9	5.3	0.6						165.4

Relativity Mission/Gravity Probe-B

The development of the Relativity mission began in 1993, after many years of studying mission design alternatives and developing the advanced technologies required for this mission to verify Einstein's theory of general relativity. The award of the spacecraft development contract was made in 1994. The scheduled launch date is October 2002, using a Delta II launch vehicle. This launch date reflects a two-year slip from the original baseline date for launch of the Relativity Mission. NASA has rebaselined the mission and is continuously monitoring all critical milestones, in particular the following:

- Milestone #18 – Post Acoustic Functional Testing Complete - March, 2001
- Milestone #23 – Integrated Payload Testing Complete - September, 2001

Should the program miss any of the above milestones or should cost trends become unfavorable, NASA will review the impact. Depending upon the assessment of the impact, NASA may initiate a termination review for Gravity Probe-B.

The estimates provided below include funding for the experiment development activities, a minimum of 16 months of mission operations, and the launch services. These estimates are the amounts included in the Science, Aeronautics and Technology appropriation for this program. They do not include the amounts for the definition phase studies carried out from FY 1985-87, but they do provide the amounts for the Shuttle Test of Relativity Experiment program initiated in FY 1988 and subsequently restructured into a ground test program only. The estimates also exclude the non-program-unique government facilities and general and administrative support used to carry out the research and development activities. A more detailed exposition of the program goals, objectives and activities is provided in the specific budget justification narrative for the program within the Space Science section.

(Budget Authority in Millions)

	PRIOR	2000	2001	2002	2003	2004	2005	2006	BTC	TOTAL
DEVELOPMENT	434.7	41.5	38.6	35.2	9.1					559.1
MISSION OPERATIONS					2.0	1.0				3.0
DATA ANALYSIS					13.6	4.0				17.6
LAUNCH SUPPORT	38.9	8.4	2.6	5.0						54.9
TRACKING & DATA SUPPORT					TBD	TBD				
TOTAL EXCLUDING CIVIL SERVICE COSTS ($I	473.6	49.9	41.2	40.2	24.7	5.0				634.6
(ESTIMATED CIVIL SERVICE FTEs)	(107)	(9)	(22)	(18)	(8)					
CIVIL SERVICE COMPENSATION ESTIMATE ($	7.1	0.9	2.1	1.8	0.8					

X-33 Advanced Technology Demonstrator

The X-33 was an integrated technology effort to flight-demonstrate key technologies required for the next generation of reusable launch vehicles (RLV). In FY 2000 one of the X-33's composite hydrogen tanks failed when the tank lobe's inner skins cracked at cryogenic temperatures, allowing liquid hydrogen leakage. This failure caused a significant slip in the program's schedule, and major rework/redesign was required. In September 2000, NASA and Lockheed Martin agreed on a path forward for the X-33 program. Based on that agreement, the focus of the program concentrated in two areas: completing the redesign and beginning the production of replacement liquid hydrogen tanks, and qualifying the flight engines for the X-33 vehicle. It was also agreed that NASA would commit no additional funding to the X-33: any NASA funds above the amount included in the initial cooperative agreement would come only from selection of the X-33 as part of the openly competed 2nd Generation RLV NASA Research Announcement (NRA) 8-30 procurement. As announced in February 2001, the X-33 program was not selected for additional funding in the 2nd Generation procurement, as NASA determined that the benefits to be derived from continuing the program did not warrant additional government investment. Therefore, the X-33 program comes to completion when the cooperative agreement between NASA and Lockheed Martin expires on March 31, 2001.

The X-33 program also funded refurbishment of rocket engine test stands at Stennis Space Center in FY 1997 ($2.3 million) and FY 1998 ($3.7 million) to enable testing of X-33 development and flight engines, as well as other future advanced space transportation engines. Civil Service estimates below are for the X-33 cooperative agreement only.

(Budget Authority in Millions of Dollars)

X-33	**PRIOR**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**TOTAL**
COOPERATIVE AND TASK AGREEMENTS	805.1	79.2							884.3
OTHER X-33 ACTIVITIES	95.5	5.4							100.9
TOTAL (EXCLUDES CIVIL SERVICE COST ($M)	900.6	84.6	0.0	0.0	0.0	0.0	0.0	0.0	985.2
ESTIMATED CIVIL SERVICE FTEs *	1,019	161	22	8	8	8	7	0	1,233
CIVIL SERVICE COMPENSATION ESTIMATE ($M)	80.6	13.8	2.1	0.8	0.9	0.9	0.8	0.0	99.9

* FTE estimates assumed continuation of the X-33 program past March 31, 2001. The decision not to continue past March 31, 2001 was made too late to fix the Agency FTE totals for this budget. The Civil Service personnel will be reallocated during FY 2003 Budget formulation.

X-34 Advanced Technology Demonstrator

The X-34 objective was to demonstrate technologies and operations concepts with the goal of reducing space transportation costs to one tenth of their current level. The Pathfinder Program formally managed the X-34 project. In FY 2000, the program was thoroughly reviewed by a NASA Risk Evaluation team. The NASA and Orbital Sciences Corporation review revealed the need to redefine the project scope, budget, and schedule. The redefined project included additional risk reduction hardware and testing that would significantly improve the likelihood of mission success. NASA required that the X-34 compete for the funds to undertake these risk reduction tasks as part of the 2nd Generation RLV Risk Reduction NRA 8-30 procurement. In February 2001, NASA announced that the X-34 work had not been selected, as NASA determined that the benefits to be derived from continuing the program did not warrant additional government investment. NASA's Office of Aerospace Technology decided to terminate the project in March 2001.

(Budget Authority in Millions of Dollars)

X-34	**PRIOR**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**TOTAL**
CONTRACT OBLIGATIONS (ORBITAL)	70.0	15.1	5.6						90.7
OTHER X-34 ACTIVITIES	53.0	49.2	12.3						114.5
TOTAL (EXCLUDES CIVIL SERVICE COST ($M)	123.0	64.3	17.9	0.0	0.0	0.0	0.0	0.0	205.2
ESTIMATED CIVIL SERVICE FTEs *	82	133	108	60	40	0	0	0	423
CIVIL SERVICE COMPENSATION ESTIMATE ($M)	8.4	13.7	11.1	6.1	4.1	0.0	0.0	0.0	43.4

* FTE estimates assumed continuation of the X-34 program past March, 2001. The decision not to continue past March, 2001 was made too late to fix the Agency FTE totals for this budget. The Civil Service personnel will be reallocated during FY 2003 Budget formulation.

X-37 Advanced Technology Demonstrator

The X-37 Space Plane is a flying testbed, a modular demonstrator vehicle that will be the first experimental X-vehicle to be flown in both orbital and reentry environments. This project is being worked under a cooperative agreement with the Boeing Co. of Seal Beach, CA. The DoD has provided additional funds, for a number of technologies of interest to them. Currently, the X-37 is slated to fly two missions on the Space Shuttle, beginning in 2003. However, results from the Second Generation Program's NRA8-30 procurement could influence not only these plans, but also future plans for the X-37.

In FY2001, approach and landing tests of the X-40A will be completed and X-37/Shuttle integration analyses will continue. Trade studies for alternate launch platforms such as an Expendable Launch Vehicle (ELV) will also be initiated. Fabrication, assembly and integration of the X-37 will be completed and the X-37 will be rolled out and pre-flight ground tests will begin. In FY 2002, the X-37 program will start approach and landing test flights and preparations for the first Shuttle or ELV flight will begin.

(Budget Authority in Millions of Dollars)

X-37	**PRIOR**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**TOTAL**
X-37 ACTIVITIES	23.7	22.4	41.4	23.8	20.6				131.9
TOTAL (EXCLUDES CIVIL SERVICE COST ($M)	23.7	22.4	41.4	23.8	20.6	0	0	0	131.9
(ESTIMATED CIVIL SERVICE FTEs		95	107	70	40	0	0	0	312
CIVIL SERVICE COMPENSATION ESTIMATE ($M)		9.0	10.1	6.7	3.8	0.0	0.0	0.0	29.6

Space Launch Initiative

Low-cost, reliable space transportation remains the key enabler of a more aggressive civil space program. The 2nd Generation RLV program will substantially reduce the technical, programmatic and business risks associated with developing a safe, reliable and affordable 2nd Generation RLV architecture. The program will invest in the technology, design, and advanced development efforts to enable at least two competitive options for a new architecture. By the 2005 time frame, NASA plans to enable full-scale development of commercially competitive, privately owned and operated, Earth-to-orbit Reusable Launch Vehicles (RLVs). The objective will be to dramatically improve safety while significantly reducing the cost of launch services.

The 2nd Generation RLV Program is divided into major investment areas: Systems Engineering and Requirements Definition, RLV Competition and Risk Reduction, NASA Unique Systems, Alternate Access to Station (AAS), and the Pathfinder program.

The Systems Engineering and Requirements Definition effort is critical to establishing vehicle requirements to guide investments. This activity will combine industry and government capabilities to develop detailed technical and programmatic requirements necessary to link technology and other risk reduction efforts to competing architectures. This effort will place a priority on industry and NASA systems engineering activities that seek compatible architectural solutions between commercial industry and NASA requirements. Of paramount importance is achieving significant improvements in safety, reliability and affordability.

The RLV Competition and Risk Reduction component is designed to allow the U.S. space launch industry to pursue significant technical and economic improvements. These advances must sufficiently reduce risk in order to enable a competition around 2005. NASA will pursue risk reduction efforts that will enable at least two competing architectures. The investment in 2nd Generation RLV risk reduction will be driven by the collective efforts of industry and the government and will be based on NASA needs and competing industry concepts. The risk reduction activities will include technology investments, advanced development activities and flight demonstrations or experiments. Planning calls for multiple industry awards with sufficient government insight to assure success. Government partnerships will be established to obviate redundant proprietary development paths and maximize government return on investment. The selection of industry and NASA investments will be defined consistent with the results of the Systems Engineering and Requirements Definition activities and will be demonstrated (e.g., ground, flight, scale) in the most efficient and cost-effective manner.

NASA Unique Systems is concentrated on developing and demonstrating the designs, technologies and systems level-integration issues associated with NASA-unique transportation elements and systems. This element will address the additional systems (e.g. crew transport vehicle, cargo carriers, rendezvous and docking systems) necessary to meet unique NASA mission requirements (e.g. crew transport, cargo return, emergency rescue and return, on-orbit service) using commercial launch vehicles. The content of this program element will be defined through the systems engineering and requirements definition process and will be concurrent with the RLV Competition and Risk Reduction activities. NASA will seek the development of unique assets that could be operated in conjunction with multiple commercially provided RLV assets. This program element will consist of contracted efforts in combination with government design, development and integration activities. Solicitations for industry involvement are being conducted in parallel with the RLV Competition and Risk Reduction solicitations.

The fourth program element, Alternate Access to Station, seeks to take advantage of all potential sources of access to space on U.S. launch systems to meet the Agency's requirements. This element supports use of existing and emergent commercial launch vehicles that could launch NASA science payloads and potentially service Space Station requirements and includes necessary risk reduction activities to meet NASA's requirements. NASA will use the Next Generation Launch Services (NGLS), Small Expendable Launch Vehicle Service (SELVS), and NASA Launch Services (NLS) acquisition path as a means to develop contractual relationships with multiple emerging and existing U.S. vendors to meet this objective. These contracts will be for fixed-price services for indefinite delivery indefinite quantity launch contracts.

The Pathfinder program was a separate focused activity in prior years, but has now been consolidated within the 2nd Generation RLV program, in keeping with the common objectives of both activities. The objective of the Pathfinder program is to flight-demonstrate advanced space transportation technologies through the use of flight experiments and experimental vehicles, in support of the goal of dramatically reducing the cost of access to space.

(Budget Authority in Millions of Dollars)

Space Launch Initiative	**PRIOR**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**TOTAL**
SYSTEMS ENGINEERING & REQUIREMENTS DEFINITION	0.0	0.0	49.9	50.0	25.0	10.0	10.0	20.0	164.9
RLV COMPETITION & RISK REDUCTION	0.0	0.0	94.8	287.0	556.0	811.0	599.0	789.0	3,136.8
NASA UNIQUE SYSTEMS	0.0	0.0	41.7	78.8	109.0	130.0	390.0	390.0	1,139.5
ALTERNATE ACCESS TO STATION	0.0	0.0	39.9	34.2	54.4	60.0	65.0	65.0	318.5
PATHFINDER	36.0	34.5	45.2	25.0	20.6				161.3
TOTAL (EXCLUDES CIVIL SERVICE COST ($M)	36.0	34.5	271.5	475.0	765.0	1,011.0	1,064.0	1,264.0	4,921.0
(ESTIMATED CIVIL SERVICE FTEs	0	107	223	187	188	153	153	153	1,164
CIVIL SERVICE COMPENSATION ESTIMATE ($M)	0.0	9.8	21.9	18.7	19.7	17.3	18.1	19.0	124.5

AVIATION SYSTEMS CAPACITY

The goal of the Aviation System Capacity (ASC) program is to enable safe increases in the capacity of major US and international airports through both modernization and improvements in the Air Traffic Management System, and through the introduction of new vehicle classes that can potentially reduce congestion.

The FAA "Aerospace Forecasts 2000-2011" report predicts that U.S. scheduled domestic enplanements will increase 55% over the next 12 years. Flight delays continue to escalate. The number of delayed flights in the National Airspace System has more than doubled in just the last 6 years. Due to environmental issues and cost, only one major new U. S. airport – in Denver – was opened this past decade. With little ability to build new or expand current airports in the populated areas where they are needed, the capacity of the nation's air transportation system will not meet consumer demand, airport delays will continue to accelerate, and the nation's economy will be adversely impacted.

To meet these growing capacity demands, more efficient and flexible routing, scheduling, and sequencing of aircraft in all weather conditions are critically needed. The ASC program is composed of the Terminal Area Productivity (TAP), Advanced Air Transportation Technologies (AATT), the Aviation System Technology Advanced Research (AvSTAR), and the Short Haul Civil Tiltrotor (SHCT) projects. The TAP project, which was completed in FY 2000, developed revolutionary technology and procedures to enable safe clear-weather airport capacity in instrument weather conditions. The AATT project develops decision-making technologies and procedures to enable substantial increases in the throughput, predictability, flexibility and efficiency of the national air transportation system in the context of the FAA commitment to "Free Flight". The SHCT project develops technologies and procedures to overcome the most critical inhibitors to a civil tiltrotor operating within an improving and modernized air traffic system. The AvSTAR Project will develop revolutionary new operational concepts for the aviation system beyond "Free Flight" and the capability to validate these concepts and their benefits in high fidelity simulation and modeling. The ASC program works closely with manufacturers, the airlines, the FAA, and the technology customers who collectively will identify operational requirements and will apply candidate technologies as operational systems.

(Budget Authority in Millions of Dollars)

ASC	PRIOR	2000	2001	2002	2003	2004	2005	2006	TOTAL
AATT	96.9	45.0	59.8	77.6	71.6	53.1			404.0
TAP	97.8	9.7	5.4						112.9
CIVIL TILTROTOR	48.6	8.2	3.2						60.0
VIRTUAL AIR SPACE MODELING				23.0	23.0	23.0	51.0	70.0	190.0
TOTAL (EXCLUDES CIVIL SERVICE COST ($M)	243.3	62.9	68.4	100.6	94.6	76.1	51.0	70.0	766.9
(ESTIMATED CIVIL SERVICE FTEs	0	245	196	221	225	218	197	197	1499
CIVIL SERVICE COMPENSATION ESTIMATE ($M)	0.0	23.4	18.7	21.1	21.2	20.6	18.8	18.8	142.6

Aviation Safety Program

The worldwide commercial aviation major accident rate has been nearly constant over the past 2 decades. While the rate is very low (approximately one hull loss per 2 million departures), increasing traffic over the years has resulted in the absolute number of accidents also increasing. The worldwide demand for air travel is expected to increase even further over the coming 2 decades - more than doubling by 2017. Without an improvement in the accident rate, such a traffic volume would lead to 50 or more major accidents a year – a near weekly occurrence. Given the very visible, damaging, and tragic effects of even a single major accident, even approaching this number of accidents would clearly have an unacceptable impact upon the public's confidence in the aviation system, and impede the anticipated growth of the commercial air-travel market. The safety of the general aviation (GA) system is also critically important. The current GA accident rate is many times greater than that of scheduled commercial transport operations. The GA market may grow significantly in future years. Safety considerations must be removed as a barrier if this growth is also to be realized. Controlled-Flight Into Terrain (CFIT) and loss of control are the two largest commercial accident types, with weather, approach and landing, and on-board fire as additional significant categories. Human error is cited above all other issues as the prime contributing factor. For GA, weather issues, CFIT, and loss of control also dominate the accident statistics.

In February 1997, to aggressively address these issues, a national goal was announced to reduce the fatal accident rate for aviation by 80% within 10 years. This national aviation safety goal is an ambitious and clear challenge to the aviation community. NASA responded to the challenge with an immediate major program planning effort to define the appropriate research to be conducted by the Agency. Four industry- and government-wide workshops were conducted in early 1997 to define research needs. Four hundred persons from over one hundred industry, government, and academic organizations actively participated in setting the research investment strategies. This led to NASA's aviation safety initiative and a redirection of the Aeronautics Research and Technology Base in FY 1998 to immediately augment aviation safety research. The Aviation Safety Program (AvSP) is NASA's next step in responding to the challenge. The goal of the AvSP is to develop and demonstrate technologies that contribute to a reduction in the aviation accident fatal rate by a factor of 5 by the year 2007 compared to the 1994-1996 average.

(Budget Authority in Millions of Dollars)

AvSP	**PRIOR**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**TOTAL**
FOCUSED PROGRAM		64.4	70.8	70.0	85.0	87.3	114.0	100.0	591.5
R&T BASE PROGRAM (NOT INCLUDED ABOVE)	108.2	31.3	30.3	27.0					196.8
TOTAL (EXCLUDES CIVIL SERVICE COST ($M)	108.2	95.7	101.1	97.0	85.0	87.3	114.0	100.0	788.3
ESTIMATED CIVIL SERVICE FTEs	0	262	254	246	246	276	242	237	1763
CIVIL SERVICE COMPENSATION ESTIMATE ($M)	0.0	25.0	24.2	23.4	23.8	26.0	24.2	21.8	168.4

Ultra-Efficient Engine Technology

The attainment of Aerospace Technology Enterprise goals requires comprehensive propulsion technology research and development spanning a broad range of aircraft applications. The timing is right to invest in breakthrough technologies for a new breed of radically improved propulsion systems to power a new generation of aircraft required in the increasingly constrained airspace system.

The Ultra-Efficient Engine Technology Program addresses the most critical propulsion issues facing the Nation in the new millennium: performance and efficiency. In order to sustain the desirable forecasted in the Nation's air system, performance and efficiency must improve without incurring environmental penalties. Additionally, it is important to sustain high reliability and safe operation without impacting the economics of operations. These propulsion technologies will also be of significant benefit to military engines where performance improvement is the principal goal driving DoD propulsion development for future military aircraft.

(Budget Authority in Millions of Dollars

UEET	**PRIOR**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**TOTAL**
UEET PROGRAM	0.0	68.3	47.9	40.0	50.0	50.0	50.0	50.0	356.2
TOTAL (EXCLUDES CIVIL SERVICE COST ($M)	0.0	68.3	47.9	40.0	50.0	50.0	50.0	50.0	356.2
(ESTIMATED CIVIL SERVICE FTEs	0	262	254	246	246	276	242	237	1763
CIVIL SERVICE COMPENSATION ESTIMATE ($M)	0.0	25.0	24.2	23.4	23.8	26.0	24.2	21.8	168.4

High Performance Computing And Communications

The main objective of the Federal HPCC R&D programs has been to extend U.S. technological leadership in high-performance computing and computer communications. As this has been accomplished, these technologies were widely disseminated to accelerate the pace of innovation and improve national economic competitiveness, national security, education, health care, and the global environment.

NASA's primary contribution to the Federal program has been its leadership in the development of algorithms and software for high-end computing and communication systems which will increase system effectiveness and reliability, as well as support the deployment of high-performance, interoperable, and portable computational tools. As HPCC technologies have been developed, NASA has been using them to address aerospace transportation systems, Earth sciences, and space sciences research challenges. The HPCC Program has supported research, development, and prototyping of technology and tools for education, with a focus on making NASA's data and knowledge accessible to America's students.

In support of these objectives, the NASA HPCC Program has developed, demonstrated, and prototyped advanced technology concepts and methodologies, provided validated tools and techniques, and responded quickly to critical national issues. As technologies have matured, the NASA HPCC Program has facilitated the infusion of key technologies into NASA missions activities, the national engineering, science and education communities, and the American public. The Program is conducted in cooperation with other U.S. Government programs, U.S. industry, and the academic community.

To focus on higher priority information technology investments, the Computational Aeroscience, NASA Research and Education Network and Remote Exploration and Experimentation projects will be terminated at the end of FY 2001.

(Budget Authority in Millions of Dollars)

HPCC	**PRIOR**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**TOTAL**
COMPUTATIONAL AEROSCIENCE	234.7	24.2	22.2						281.1
INFO INFRASTRUCTURE & APPLICATIONS	23.4								23.4
NASA RESEARCH & EDUCATION NETWORK	4.1	4.4	2.9						11.4
EARTH & SPACE SCIENCES	145.9	21.9	21.8	21.8	21.8	11.2			244.4
REMOTE EXPLORATION & EXPERIMENTATION	18.8	14.6	18.9						52.3
LEARNING TECHNOLOGY	21.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	49.0
TOTAL (EXCLUDES CIVIL SERVICE COST ($M)	447.9	69.1	69.8	25.8	25.8	15.2	4.0	4.0	661.6
(ESTIMATED CIVIL SERVICE FTEs	32	149	151	31	31	31	2	0	427
CIVIL SERVICE COMPENSATION ESTIMATE ($M)	0.0	10.9	10.5	2.2	2.3	2.4	0.5	0.5	29.3

Hypersonic-X (Hyper-X)

The Hypersonic research program is designed to validate the technologies required to test flight a ramjet to scramjet engine transformation, while in-flight. The first flight-test for the Hypersonic-X Research Vehicle (HXRV) was delayed until FY 2001 due to an additional workload supporting an increase for safety and risk mitigation to ensure mission success.

Hyper-X is part of the Vehicle Systems Technology program, which is focused on development of revolutionary new technologies to improve the performance of air vehicles and space transportation vehicles that support Aerospace Enterprise Goals and Objectives. Tasks include the first flight of the Mach 7 Hyper-X vehicle and first flight at Mach 10.

(Budget Authority in Millions of Dollars)

Hyper-X	**PRIOR**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**TOTAL**
HYPER-X PROJECT	99.0	44.6	31.1	8.0					182.7
TOTAL (EXCLUDES CIVIL SERVICE COST ($M)	99.0	44.6	31.1	8.0	0.0	0.0	0.0	0.0	182.7
(ESTIMATED CIVIL SERVICE FTEs *									
CIVIL SERVICE COMPENSATION ESTIMATE ($M) *									

* HYPER-X is a project within the Vehicle Systems Technology program: NASA tracks Civil Service FTEs and compensation only down to the program level, thus no separate data is available for HYPER-X

Environmental Research & Sensor Technology (ERAST)

The ERAST Project is a part of the Flight Research Base R&T Program which continued, during Fiscal year 2000, to safely conduct, enable, and improve NASA's atmospheric flight research capability. Research activities were conducted in the Environmental Research Aircraft and Sensor Technology (ERAST) project with the initial low-altitude flights of the Helios aircraft, which has a 247-foot wingspan and an ultimate altitude goal of 100,000-feet. Preparations are underway to ship the Helios flight and ground support equipment for the summer 2001 deployment where flight to 100,000 feet altitude will be demonstrated. Full deployment will be completed in April 2001. Low-altitude flights are expected to begin late May 2001. The Helios aircraft has commercial market potential as a communications relay platform and Dryden has prepared an implementation approach to Helios technology commercialization for the NASA technology/commercialization office. As a highlight of ERAST FY 2000 flight activities, Dryden completed a GPRA milestone of demonstrating over-the-horizon control of a remotely piloted aircraft outside of controlled airspace using commercial satellite networks. This milestone validated a technology to meet the Earth Science Enterprise requirements for research aircraft to conduct in-situ atmospheric data collection. Also within the ERAST project, the Predator B successfully completed its initial flights in early February 2001. This is a significant achievement towards completing the September 2002 milestone of flight -demonstrating RPA capability to conduct science missions.

(Budget Authority in Millions of Dollars)

ERAST	**PRIOR**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**TOTAL**
BOLD ERAST	86.1	20.0	13.0	10.5					129.6
ERAST II			12.0	11.5	20.0				43.5
TOTAL (EXCLUDES CIVIL SERVICE COST ($M)	86.1	20.0	25.0	22.0	20.0	0.0	0.0	0.0	173.1
(ESTIMATED CIVIL SERVICE FTEs *									
CIVIL SERVICE COMPENSATION ESTIMATE ($M) *									

* ERAST is a project within the Flight Research program: NASA tracks Civil Service FTEs and compensation only down to the program level, thus no separate data is available for ERAST.

Quiet Aircraft Technology Program

The goal of the Quiet Aircraft Technology program is to contribute to the objectives of the Global Civil Aviation enabling technology goals, as stated in the Office of Aerospace Technology Enterprise Strategic Plan, "Reduce the perceived noise levels of future aircraft by a factor of two from today's subsonic aircraft within ten years, and by a factor of four within 25 years." Achievement of the 25-year goal will fulfill NASA's vision of a noise constraint-free air transportation system with the objectionable aircraft noise contained within the airport boundaries. Part of this vision is a transportation system with no need for curfews, noise budgets, or noise abatement procedures. Benefits to the public of achieving these goals include increased quality of life, readily available and affordable air travel, and continued U. S. global leadership.

(Budget Authority in Millions of Dollars)

QAT	PRIOR	2000	2001	2002	2003	2004	2005	2006	TOTAL
QUIET AIRCRAFT TECHNOLOGY PROGRAM	0.0	18.3	20.0	20.0	20.0	20.0	20.0	20.0	138.3
TOTAL (EXCLUDES CIVIL SERVICE COST ($M)	0.0	18.3	20.0	20.0	20.0	20.0	20.0	20.0	138.3
(ESTIMATED CIVIL SERVICE FTEs	0	0	5	5	5	5	5	5	30
CIVIL SERVICE COMPENSATION ESTIMATE ($M)	0.0	0.0	0.5	0.5	0.6	0.6	0.6	0.6	3.4

Small Air Transport System

The goal of the five-year Small Aircraft Transportation System program is to develop key airborne technologies and provide a proof-of-concept evaluation for precision guidance of small aircraft to virtually any touchdown zone at small airports. The objective is to allow the use of underutilized airports (including those without control towers, radar, or precision instrument approaches) as well as underutilized airspace (such as the low-altitude, non-radar airspace below 6,000 feet and the enroute structure below 18,000 feet). If successful, the initial SATS operating capabilities have the potential to create alternative means to respond to the demand for increased throughput in the National Airspace System in the near term. In the future, the SATS technology investments create potential alternatives for addressing the nation's challenge of unmet transportation demand related to the spreading of congestion on highways and in the major airport system.

The SATS program intends to enable the adoption of three operational capabilities that are not possible in the current NAS environment: Higher Volume Operations at Non-Towered/Non-Radar Airports; Lower Landing Minimums at Minimally Equipped Landing Facilities; Flight Systems for Improved Total System Performance. To enable these operational capabilities, the program is focused on developing the key airborne technologies to support the creation and evaluation of SATS operating capabilities. Coordination with other NASA programs, particularly the Aviation Safety and Aviation Systems Capacity programs, will be maintained to ensure technologies being developed in those programs can be leveraged to support the SATS concept and facilitate success. Coordination with the ASC program is also important to ensure that a fourth operational capability, enroute procedures and systems for integrated fleet operations, is addressed to enable integration of SATS-equipped aircraft into the higher en route air traffic and controlled terminal airspace. These technologies would enable near-all-weather operations by new generations of such aircraft at virtually any landing facility in the nation.

The outcome of the five-year proof of concept includes experimental data from flight and simulation evaluations as well as analysis of the implications of technologies on transportation system decision-making. A significant part of the strategy for achieving the SATS goal is participation by the Federal Aviation Administration (FAA). A Memorandum of Agreement between NASA and the FAA will guide this participation and ensure that the technology development and proof-of-concept evaluations addresses issues associated with aircraft certification, flight standards, air traffic, and airports. It will also be the documentation that provides for sharing of resources and the conduct of joint planning and implementation. Similar memoranda will be established with state and local governments and local airport authorities, as participation by these organizations is also important for the success of SATS.

(Budget Authority in Millions of Dollars)

SATS	**PRIOR**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**TOTAL**
SMALL AIR TRANSPORT SYSTEM	0.0	0.0	9.0	15.0	20.0	20.0	5.0	0.0	69.0
TOTAL (EXCLUDES CIVIL SERVICE COST ($M)	0.0	0.0	9.0	15.0	20.0	20.0	5.0	0.0	69.0
(ESTIMATED CIVIL SERVICE FTEs	0	0	1	3	3	3	3	0	13
CIVIL SERVICE COMPENSATION ESTIMATE ($M)	0.0	0.0	0.2	0.3	0.3	0.4	0.4	0.0	1.6

International Space Station

In FY 1983, NASA received approval to enter into a preliminary definition phase of a space station. A cost target was established at that time by President Reagan; this target provided guidance to the team undertaking the definition of what capabilities a space station could have for this amount of money. Due to the uncertainty of future inflation, the target was expressed in constant 1984 dollars. The target value of $8 billion was intended to cover the costs which would be incurred to perform the preliminary definition and the development of space station hardware and ground systems. The President also directed NASA to solicit the involvement of international parties in the space station.

After three years studying numerous design concepts, a final reference design was established by NASA and our international partners--Japan, Canada, and the member nations of the European Space Agency. Prior to requesting from the Administration and Congress the authority to proceed into the development phase, NASA undertook a comprehensive cost estimate. The resultant estimate of $14.5 billion (expressed in 1984 dollars for comparison purposes) was presented to the Administration in early 1987. After consideration, the Administration directed a National Research Council (NRC) review of the reference design and the cost estimate. The NRC reported back that the space station could be built in two phases, with the second phase adding the dual keel configuration, the co-orbiting platform, servicing capabilities, and additional solar dynamic power modules. The NRC included in its estimate of $21.0-25.0 billion (1984 dollars), a number of additional cost elements: operations, marginal Shuttle flight costs, a crew rescue vehicle, civil service salaries and expenses, facilities, and provision for additional testing and backup hardware. These estimates were furnished to the Congress in mid-1987 for their review prior to action on NASA's FY 1988 appropriation.

Over each ensuing year, Congress approved continuation of the Space Station Freedom program, but reduced each year's appropriations request. On several occasions, Congress directed NASA to redesign the Station to conform not only to the reduced appropriations request in that year but also to reduced projections of future funding availability for NASA's overall budget. In early 1993, the Administration directed NASA to undertake a 90 day study of lower cost redesign options for the Space Station, and appointed an Advisory Committee on the Redesign of the Space Station. In June 1993, upon receiving the final reports and the Advisory Committee's recommendations, the Administration selected an option (A) from the three options presented and directed NASA to execute the Space Station program for no greater than $2.1 billion per year. This figure encompassed not only the development and operational costs of the Space Station itself but also the costs for a program of precursor scientific research, the expenses for integrating the Space Shuttle and the Space Station and the development of experimental facilities and capabilities for the Space Station. The cap excluded the costs of civil service salaries and expenses, Space Shuttle operational flight costs, and performance improvements to the Shuttle.

In the Fall of 1993, with the U.S. playing the lead role, the international partnership invited the Russian Government to become a participant in the program. The Russians offered access to their Mir space station in the interim period between 1995 and the beginning of the international Space Station's assembly. The Congress and Administration agreed in late 1993 that the $100 million amount to be paid annually to the Russian Space Agency for hardware and services over the FY 1994-97 period was outside the $2.1 billion annual cap. Since late 1993, the U.S. and the newly expanded set of international partners have proceeded with the final design and hardware development for an international Space Station with significantly greater capabilities for research than those which would have been provided on Space Station Freedom, or the option selected in the redesign process.

The budgetary estimates provided below include the amounts for this program in several appropriation accounts. Previous budgets provided funding for Space Station in the Human Space Flight appropriation, and through FY 1997, related research and payloads were funded in the Science, Aeronautics and Technology appropriation. In the FY 1998 budget NASA consolidated the management of Space Station research and technology, science utilization, and payload development with the Space Station development and operations program in order to enhance the integrated management of the total content of the program budget. The FY 2002 budget continues to reflect that consolidation by funding the total program budget in the International Space Station appropriation account (research budget authority will be fully transitioned back to the Office of Biological and Physical Research in the FY 2003 budget).

The Space Station project cost estimate also includes Russian Program Assurance (RPA), added in FY 1997, to fund implementation of contingency plans associated with mitigating the risks associated with potential shortfalls in planned Russian contributions. The estimate also includes funding for the X-38 project and Phase 1 of the CRV project, added to the ISS budget in FY 2000. (The CRV development and production (Phase 2) funding was shown in the outyear funding projections for Aero-Space Technology programs, in the Science, Aeronautics and Technology (SAT) appropriation account, in the FY 2001 budget runout. Those projected amounts have been redirected to the Space Station budget plan.) The FY 2002 budget proposes that the authorized funding level for the International Space Station shall not exceed $8.197 billion through FY 2006 except in amounts equal to budget reductions in other Human Space Flight programs.

The totals provide the current estimate for the costs to be incurred through the end of FY 2006. Details of the budget estimates after FY 2001 are currently under review pending an ongoing program assessment. Based on recent operational experience, continuing flight software and hardware integration issues, obsolescence issues, and realization that earlier assembly phase cost estimates were low, NASA concluded that the program baseline could not be executed on schedule within approved funding levels. A reassessment of the ISS Program budget baseline was started in FY 2000 and continued into FY 2001. The initial results, based on estimating assumptions that do not assume significant changes in cost requirements as experience is gained in operations, showed a budget shortfall of up to $4 billion over 5 fiscal years. To remain within the Agency’s budget marks, the Administration directed NASA to redirect funds from remaining high-risk, high-cost hardware development, including the Habitation Module and Crew Return Vehicle (CRV), as well as funds from the RPA budget mentioned above. The intent of this direction is to ensure that ISS funding will be contained within the budget projections, while assembly continues though U.S. Core Station Complete (deployment of Node 2 on flight 10A). This will allow for the integration of flight hardware being provided by the International Partners. In addition, the ISS Research Program is being realigned to match the on-orbit capability build-up as the program moves toward U.S. Core Complete. NASA will continue to pursue atmospheric testing of the X-38 and is assessing the affordability of completing the space flight test relative to other program priorities. Options for provision of a crew return capability and Habitat capability to support the desired increase in crew size from 3 to 6 will be discussed with the international partners. However, U.S. contributions to such capabilities will be dependent on the availability of funds within the President's five-year budget plan for Human Space Flight, resolution of technical issues, and the quality of Agency cost estimates.

Over the next several years, the Agency will press ahead with ISS assembly and the integration of the partners’ research modules. Research operations on board the ISS have been expanding since they began in FY 2000 and will greatly exceed any previous capabilities for research in space including Skylab, Shuttle, or Mir.

NASA will also undertake reforms and develop a plan to ensure that future Space Station costs will remain within the President's FY 2002 Budget runout. Key elements of this plan will: 1) restore cost estimating credibility, including an external review to validate cost estimates and requirements and suggest additional options as needed; 2) transfer Space Station program management reporting from the Johnson Space Center in Texas to NASA Headquarters until a new program management plan is developed and approved; and 3) open future Station hardware and service procurements to innovation and cost saving ideas through competition, including launch services and a Non-Government Organization for Space Station research.

The estimates do not include the amounts being contributed by the international partners, the initial $400 million contract with the Russian Space Agency for the Shuttle/Mir program, the costs of the non-program unique NASA facilities, Shuttle performance improvements and flight operations costs, and the general and administrative support used to execute the program. Additionally, the program is planned to achieve an average annual cost target of $1.3-1.5 billion when the Space Station becomes operationally mature.

The cost of Space Shuttle flights can be stated in two ways: marginal and annual average. The marginal cost of a given Shuttle flight ranges from $60 million to about $85 million, reflecting the reusable characteristics of the Space Shuttle. The annual average cost of an FY 2001 Shuttle flight is approximately $453 million. The nominal value contained in the NASA FY 2001 Authorization (H.R. 1654), pertaining to cost caps for the International Space Station, is $380 million per flight. Using that value for the approximately 30 Space Shuttle flights flown or planned to complete the U.S. Core Capability and accommodate international partner elements, the present cost estimate for Space Shuttle flights supporting Space Station is approximately $11.4 billion, including flights for partner elements.

Although assessment of the program is currently ongoing, NASA's preliminary evaluation is that this budget for Space Station is within the $25 billion cap established in the NASA FY 2001 Authorization (H.R. 1654), and that the Space Shuttle flights supporting the ISS are within the $17 billion cap. This is based on the assumption that the point at which substantial completion will be reached (less than 5 percent of the annual Space Station budget spent on development) will occur in FY 2004 when the U.S. Core Capability is reached. Total Space Station program funding from FY 1994 through FY 2004 is projected at $23.3 billion in this budget. Approximately 30 Shuttle flights are projected to be required to reach this point and accommodate international partner elements. Based on the $380 million per flight valuation in H.R. 1654, the value of 30 Shuttle flights is approximately $11.4 billion. When the program assessment is completed, NASA will review the program estimates pertaining to the caps.

A more detailed exposition of the program goals, objectives and activities is provided in the specific budget justification narrative for the program within the budget justifications for the Space Station.

International Space Station *

(Budget Authority in Millions of Dollars)

	PRIOR	1994-98	1999	2000	2001	2002	2003	2004	2005	2006	TOTAL
PROGRAM ELEMENTS		11,151.1	2,299.7	2,323.1	2,112.9	2,087.4	1,817.5	1,509.1	1,394.3	1,389.0	26,084.1
SPACE STATION	10,234.1	11,151.1	2,299.7	2,323.1	2,112.9	2,087.4	1,817.5	1,509.1	1,394.3	1,389.0	36,318.2
Vehicle	8,234.1	8,243.1	1,272.9	950.1	716.9						
Operations Capability	956.3	1,455.8	576.3	703.6	824.8						
Research	121.0	1,142.2	336.5	394.4	457.4						
Russian Program Assurance		310.0	114.0	200.0	24.0						
Crew Return Vehicle				75.0	89.8						
Other	922.7										
(Estimated Civil Service FTEs)			(2,136)	(2,340)	(2,396)	(2,573)	(2,398)	(2,306)	(2,302)	(2,298)	
Civil Service Compensation Estimate		652.7	177.6	210.3	228.2	255.6	251.0	255.4	259.2	272.7	

* Estimate total is through FY 2006. FY 2002 through 2006 estimates reflect appropriations language proposed in this FY 2002 budget that "… the authorized funding level for the International Space Station through fiscal year 2006 shall not exceed $8,197,300 except in amounts equal to budget reductions in other Human Space Flight programs."

- Allocation of FY 2002-2006 funding is currently under review and allocations to Vehicle, Operations, Research, RPA, CRV and final center distributions will be determined as part of program assessments
- The amounts shown have been restated to include the funds appropriated in FY 1997 and prior years to the Science, Aeronautics and Technology; Construction of Facilities; and Research and Development appropriations
- Civil Service FTE estimates for the International Space Station include research workforce at non-OSF centers

International Space Station

(Budget Authority in Millions of Dollars)

	1994-98	1999	2000	2001	2002	2003	2004	2005	2006[1]	TOTAL
FY 2001 Budget Est. – ISS	11,151.1	2,299.7	2,323.1	2,114.5	1,858.5	1,452.5	1,327.0	1,275.0	1,260.0	25,061.4
FY 2001 Budget Est. – CRV Phase 2					95.0	190.0	230.0	250.0	250.0	1,015.0
FY 2001 Budget Program Cost Estimate	**11,151.1**	**2,299.7**	**2,323.1**	**2,114.5**	**1,953.5**	**1,642.5**	**1,557.0**	**1,525.0**	**1,510.0**	**26,076.4**
FY 2002 Budget Program Cost Estimate	**11,151.1**	**2,299.7**	**2,323.1**	**2,112.9**	**2,087.4**	**1,817.5**	**1,509.1**	**1,394.3**	**1,389.0**	**26,084.1**
Change – ISS				-1.6	+228.9	+365.0	+182.1	+119.3	+129.0	+1,024.3
Change – CRV Phase 2					-95.0	-190.0	-230.0	-250.0	-250.0	-1,015.0
FY 2002 Budget Program Cost Estimate	**--**	**--**	**--**	**-1.6**	**+133.9**	**+175.0**	**-47.9**	**-130.7**	**-121.1**	**+7.7**
Operating Plans		**0**	**0**	**-1.6**						**-1.6**
Vehicle		+89	+60	+274						+423
Operations			-60	-2						-62
Research				+2						+2
Russian Program Assurance		-89		-276						-365
X-38/Crew Return Vehicle				-0						-0
Jan-01 Assessment Review					**+821**	**+1,038**	**+948**	**+731**	**+514**	**+4,052**
Propulsion module					+4	+131	+147	+129	+14	+424
HAB module					+132	+150	+135	+60	+38	+515
Avionics systems integrated lab					+17	+47	+41	+25	+18	+148
Prime development & ops					+448	+417	+358	+323	+293	+1,839
Non-Prime development & ops					+245	+278	+216	+228	+189	+1,156
Other re-estimates					-25	+15	+51	-34	-38	-30
Budget Reassessment (preliminary) *					**-687**	**-863**	**-996**	**-862**	**-635**	**-4,043**
Redirect Propulsion module funding					-118	-137	-153	-129	-14	-549
Redirect CRV Phase 2 funding					-95	-190	-230	-250	-250	-1,015
Redirect HAB module funding					-132	-150	-135	-60	-38	-515
Research realignment, content reductions, efficiencies and savings					-342	-386	-478	-423	-333	-1,964

* Reassessment is ongoing. Final reductions, allocations, & schedule impacts may adjust the details displayed here.

[1] FY 2006 funding displayed for the FY 2001 budget runout are nominal estimates, used for purposes of comparison to the FY 2002 budget runout